Experiment No.5
Implement Circular Queue ADT using array
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Experiment No. 5: Circular Queue

Aim: To Implement Circular Queue ADT using array

Objective:

Circular Queues offer a quick and clean way to store FIFO data with a maximum size

Theory:

Circular queue is an data structure in which insertion and deletion occurs at an two ends rear and front respectively. Eliminating the disadvantage of linear queue that even though there is a vacant slots in array it throws full queue exception when rear reaches last element. Here in an circular queue if the array has space it never throws an full queue exception. This feature needs an extra variable count to keep track of the number of insertion and deletion in the queue to check whether the queue is full or not.Hence circular queue has better space utilization as compared to linear queue. Figure below shows the representation of linear and circular queue.

Linear queue

Front rear

Circular Queue

6. Request Handling: Managing requests in web servers.

7. Bounded Buffer: Handling data between producers and consumers.

8. Job Scheduling: Scheduling tasks in computing clusters.

9. Simulation Systems: Modeling real-world scenarios.

10. Task Queues: Managing background tasks in applications.

Where is queue used in a computer system proceesing?

Queues are used in a computer system for tasks like:

1. Task scheduling in operating systems.
2. Managing I/O operations.
3. Handling print jobs.
4. Efficient interrupt handling.
5. Buffer management.
6. Job queues in computing clusters.
7. Synchronization.
8. Message queues in distributed systems.
9. Request handling in web servers.
10. Background task management in applications.

They ensure orderly and efficient processing of tasks, data, and requests.

Conclusion:

What is the structure of queue ADT?

The Queue Abstract Data Type (ADT) is a linear data structure that follows the First-In-First-Out (FIFO) principle, meaning that the first element added to the queue is the first one to be removed. The basic operations and characteristics of a queue ADT include:

1. Enqueue:Adds an element to the back (rear) of the queue.

2. Dequeue: Removes and returns the element from the front (head) of the queue.

3. Peek (or Front): Allows you to view the element at the front of the queue without removing it.

4. IsEmpty: Checks if the queue is empty.

5. Size: Returns the number of elements currently in the queue.

A simple real-life analogy for a queue is a line of people waiting for a service, where the person who arrives first is the first to be served.

List various applications of queues?

Here are various applications of queues:

1. Print Queue: Managing print jobs in order.

2. Task Scheduling: Scheduling tasks in operating systems.

3. Breadth-First Search: Traversing graphs level by level.

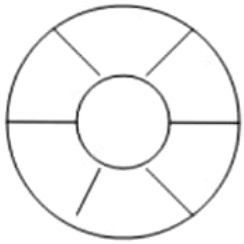
4. Call Center Systems: Handling customer service calls.

5. Buffer Management: Storing data in a temporary buffer.

```
printf("\n QUEUE IS EMPTY");
return -1;
}
else {
return queue[front]; }
}
void display() {
int i;
printf("\n");
if(front == -1 || front > rear)
printf("\n QUEUE IS EMPTY");
else {
for(i = front;i <= rear;i++)
printf("\t %d", queue[i]);
}
}
```

Output:

```
***** MAIN MENU *****"
1. Insert an element
2. Delete an element
3. Peek
4. Display the queue
5. EXIT
Enter your option : 1
Enter the number to be inserted in the queue : 50
```



Algorithm

Algorithm : ENQUEUE(Item)

Input : An item is an element to be inserted in a circular queue.

Output : Circular queue with an item inserted in it if the queue has an empty slot.

Data Structure : Q be an array representation of a circular queue with front and rear pointing to the first and last element respectively.

1. If front = 0
   front = 1
   rear =1
   Q[front] = item
2. else
   next=(rear mod length)
   if next!=front then
   rear = next
   Q[rear] = item
   Else
   Print "Queue is full"
   End if
   End if
3. stop

Algorithm : DEQUEUE()

Input : A circular queue with elements.

Output :Deleted element saved in Item.

Data Structure : Q be an array representation of a circular queue with front and rear pointing to the first and last element respectively.

1. If front = 0
   Print "Queue is empty"

Exit

2. else

item = Q[front]

if front = rear then

rear = 0

front=0

else

front = front+1

end if

end if

3. stop

Code:

```
#include<stdio.h>
 #include<conio.h>
 #define MAX 10
int queue[MAX];
 int front=-1, rear=-1;
 void insert(void);
int delete_element(void);
 int peek(void);
 void display(void);
 int main() {
int option, val;
clrscr();
```

```
do {
printf("\n ***** MAIN MENU *****");
printf("\n 1. Insert an element");
printf("\n 2. Delete an element");
printf("\n 3. Peek");
printf("\n 4. Display the queue");
printf("\n 5. EXIT");
printf("\n Enter your option : ");
scanf("%d", &option);
switch(option) {
case 1:
insert();
break;
case 2:
val = delete_element();
if(val!=-1)
printf("\n The number deleted is : %d", val);
break;
case 3:
val = peek();
if(val!=-1)
printf("\n The first value in queue is : %d", val);
break;
case 4:
display();
break;
```

```
 }
 }
while(option!=5);
 getch();
return 0; }
 void insert() {
 int num;
printf("\n Enter the number to be inserted in the queue : ");
 scanf("%d", &num);
if(front==0 && rear==MAX-1)
printf("\n OVERFLOW");
else if(front==-1 && rear==-1) {
 front=rear=0;
 queue[rear]=num; }
else if(rear==MAX-1 && front!=0) {
rear=0;
 queue[rear]=num;
} else {
rear++;
queue[rear]=num;
 }
 } int delete_element() {
 int val;
 if(front==-1 && rear==- 1)
{ printf("\n UNDERFLOW");
return -1;
```

```
}
 val = queue[front];
 if(front==rear)
front=rear=-1;
else {
if(front==MAX-1)
front=0;
 else
front++;
 } return val;
 } int peek() {
 if(front==-1 && rear==- 1) {
 printf("\n QUEUE IS EMPTY");
 return -1; }
 else
{ return queue[front];
 }
 } void display() {
 int i;
 printf("\n");
 if (front ==-1 && rear= =-1)
 printf ("\n QUEUE IS EMPTY");
else {
if(front<=rear;i++)
 printf("\t %d", queue[i]);
} else {
```

```
for(i=front;i<=rear;i++)
 printf("\t %d", queue[i]);
}
 }
 }
```

Output:

```
***** MAIN MENU *****
1. Insert an element
2. Delete an element
3. Peek
4. Display the queue
5. EXIT
Enter your option : 1
Enter the number to be inserted in the queue : 25
Enter your option : 2
The number deleted is : 25
Enter your option : 3
QUEUE IS EMPTY
Enter your option : 5
```

Conclusion:

Explain how Josephus Problem is resolved using circular queue and elaborate on operation used for the same.

1. Initialize a circular queue with the same number of elements as there are people in the circle.
2. Enqueue all people (or items) into the circular queue, assigning a position number to each.
3. Begin eliminating people by dequeuing every 'k-th' person from the queue.
4. Enqueue the eliminated person's position number back into the queue.
5. Repeat steps 3 and 4 until only one person (or item) remains in the queue.

The key operation used for resolving the Josephus Problem is dequeuing every 'k-th' person, effectively simulating the elimination process while maintaining the circular nature of the queue. Enqueuing the eliminated person's position number back into the queue ensures that the circle is maintained, and the process continues until the final person (or item) is left.

In summary, using a circular queue allows for an efficient and straightforward implementation of the Josephus Problem, ensuring that the 'k-th' person is eliminated in a circular fashion until only one remains.